International Energy Module

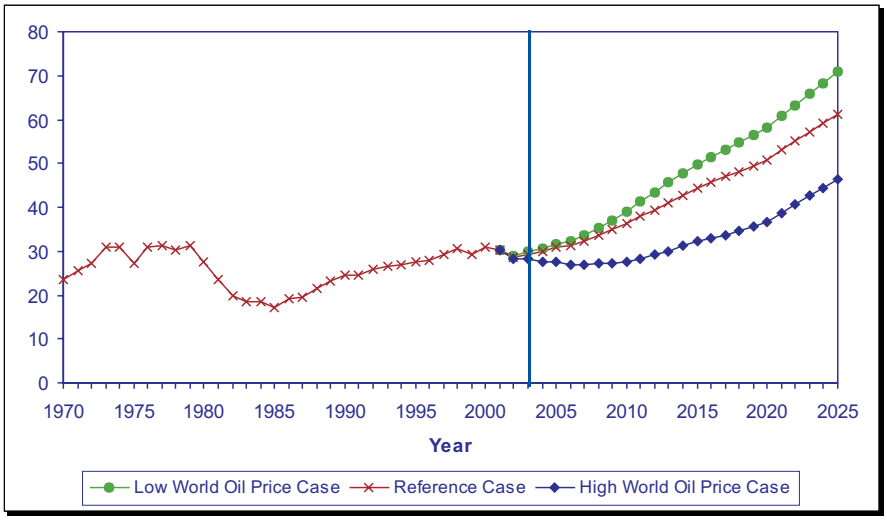
The International Energy Module determines changes in the world oil price and the supply prices of crude oils and petroleum products for import to the United States in response to changes in U.S. import requirements. A market clearing method is used to determine the price at which worldwide demand for oil is equal to the worldwide supply. The module determines new values for oil production and demand for regions outside the United States, along with a new world oil price that balances supply and demand in the international oil market. A detailed description of the International Energy Module is provided in the EIA publication, *Model Documentation Report: The International Energy Module of the National Energy Modeling System*, DOE/EIA-M071(99), (Washington, DC, February 1999).

Key Assumptions

The level of oil production by countries in the Organization of Petroleum Exporting Countries (OPEC) is a key factor influencing the world oil price projections incorporated into *AEO2003*. Non-OPEC production, worldwide regional economic growth rates and the associated regional demand for oil are additional factors affecting the world oil price.

OPEC oil production is assumed to increase throughout the forecast, making OPEC the primary source, satisfying the worldwide increase in oil consumption expected over the forecast period (Figure 2). OPEC is assumed to be the source of additional production because its member nations hold a major portion of the world's total reserves—exceeding 818 billion barrels, more than 79 percent of the world's estimated total, at the end of 2001.[4] For the *AEO2003* forecasts, three different OPEC production paths are the principal assumptions leading to the three world oil price path cases examined: the low oil price case, reference case, and high oil price case. The values assumed for OPEC production for the three world oil price cases are given in Figure 2. Iraq is assumed to continue selling oil only at United Nations Security Council sanction-allowed volumes until at least 2004. Once sanctions are lifted, Iraq will increase production levels to over 4 million barrels per day within 2 years. Within a decade of sanctions being lifted, Iraq is expected to increase production capacity to more than 6 million barrels per day with likely investment help from foreign sources. Non-OPEC oil production is expected to follow a gradually rising path—with an increase of more than 1.1 percent per year over the forecast period—as advances in both exploration and extraction technologies result in this upward trend (Figure 3). One fixed path for non-OPEC oil production is initially

Figure 2. OPEC Oil Production, 1970-2025
(Million Barrels per Day)

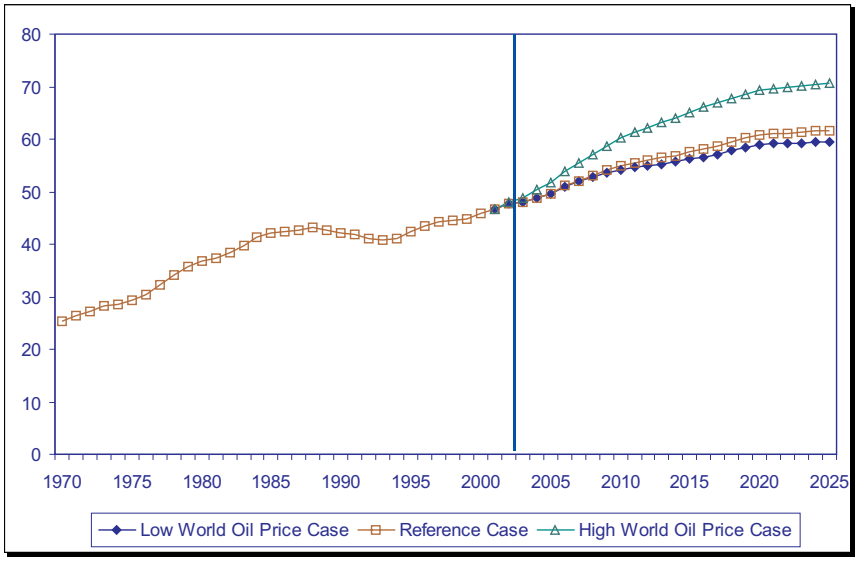


OPEC = Organization of Petroleum Exporting Countries.

Sources: Energy Information Administration. AEO2003 National Energy Modeling System runs lw2003.d110502c, aeo2003.d110502c, and hw2003.d110502c.

input for all three world oil price case projections. Non-OPEC production depends upon world oil prices, so the final forecast solutions of the levels of non-OPEC production for the three oil price cases diverge from the initial assumptions. Production is higher in the high oil price case since more marginal wells are profitable at the higher prices. Likewise, lower world oil prices are associated with lower production levels. The final non-OPEC production paths for the three oil price cases are shown in Figure 3.

Figure 3. Non-OPEC Oil Production, 1970-2025
(Million Barrels per Day)



OPEC = Organization of Petroleum Exporting Countries.

Sources: Energy Information Administration. AEO2003 National Energy Modeling System runs lw2003.d110502c, aeo2003.d110502c, and hw2003.d110502c.

The non-U.S. oil production forecasts in the *AEO2002* begin with country-level assumptions regarding proved oil reserves. These reserve estimates are shown in Table 7 and are compiled by PennWell Publishing Company's *Oil and Gas Journal*.

Table 7. Worldwide Oil Reserves as of January 1, 2002
(Billion Barrels)

Region	Proved Oil Reserves
Western Hemisphere	149.8
Western‘Europe	17.1
Asia-Pacific	43.8
Eastern Europe and F.S.U.	58.6
Middle East	685.6
Africa	76.7
Total World	1,031.6
Total OPEC	818.8

Source: PennWell Publishing Co., International Petroleum Encyclopedia, (Tulsa, OK, 2002).

The assumed growth rates for GDP for various regions in the world are shown in Table 8. This set of growth rates for GDP was assumed for all three price cases. The GDP growth rate assumptions are from Global Insight's DRI-WEFA August 2002 World Economic Outlook.

The values for growth in oil demand calculated in the International Energy Module, which depend upon the oil price levels as well as the GDP growth rates, are shown in Table 9 for the three oil price cases by regions.

Table 8. Average Annual Regional Gross Domestic Product Growth Rates, 2001-2025
(Percent per Year)

Region	Gross Domestic Product
Industrialized Countries	2.6
Other Developing Countries	4.2
Eurasia	5.4
China	6.4
Former Soviet Union	3.9
Eastern Europe	4.1
Total World	3.1

Source: Global Insight's DRI-WEFA, World Economic Outlook, (Lexington, MA, August 2002).

Table 9. Average Annual Regional Growth Rates for Oil Demand, 2001-2025
(Percent per Year)

Region	Low Price	Reference	High Price
Industrialized Countries	1.6	1.3	1.1
Other Developing Countries	2.9	2.8	2.6
Eurasia	3.3	3.1	2.9
China	4.2	3.9	3.7
Former Soviet Union	2.1	2.0	1.8
Eastern Europe	2.4	2.2	2.2
Total World	2.3	2.0	1.8

Source: Energy Information Administration, *AEO2003* National Energy Modeling System runs: lw2003.d110502c; aeo2003.d110502c; and hw2003.d110502c.

Petroleum product imports are represented in the projections through a series of curves that present the quantity of each product that the world market is willing to supply to U.S. markets for each of the five Petroleum Administration for Defense Districts (PADDs). Curves are provided for ten products: traditional gasoline (including aviation), reformulated gasoline, No. 2 heating oil, low-sulfur distillate oil, high- and low-sulfur residual oil, jet fuel (including naptha jet), liquefied petroleum gas, petrochemical feedstocks, and other. The curves are calculated using the World Oil Refining Logistics Demand (WORLD) Model.[5] The WORLD model uses as inputs worldwide demand for crude oil and petroleum products for world oil prices that are close to the oil prices assumed for *AEO2003*, as well as values for worldwide petroleum production that are consistent with such prices. The refinery technology incorporated in the model is updated using the most recently available Oil & Gas Journal Database.[6]

Notes and Sources

[4] PennWell Publishing Co., International Petroleum Encyclopedia, (Tulsa, OK, 2002).

[5] EIA, EIA Model Documentation: World Oil Refining Logistics Demand Model, "WORLD" Reference Manual, DOE/EIA-M058, (Washington, DC, March 1994).

[6] Oil & Gas Journal, World Wide Refinery Survey, (data as of January 1, 2002).